

**REMARKS**

Claims 1-20 are pending in this application. By the Office Action, claims 1-14 are rejected under 35 U.S.C. §103(a). By this Amendment, claims 15-20 are added. Support for new claims 15-20 can be found in the original claims as filed.

**I. Darolia and Naik**

**A. Claims 1-6**

The Office Action rejects claims 1-6 under 35 U.S.C. §103(a) over U.S. Patent No. 6,444,057 to Darolia et al. ("Darolia") in view of U.S. Patent No. 5,077,141 to Naik et al. ("Naik"). Applicants respectfully traverse the rejection.

Independent claim 1 is drawn to a nickel alloy composition that includes about 0.05 to about 0.3 wt% silicon, and claims 2-6 depend from claim 1. However, Darolia and Naik, alone or in combination, do not teach or suggest such an alloy composition.

As acknowledged in the Office Action, Darolia describes a nickel alloy composition that does not include silicon. However, the Office Action alleges that Naik teaches the addition of silicon to a nickel base alloy for improved oxidation and corrosion resistance and concludes that it would have been obvious to one of ordinary skill in the art to add silicon to the Darolia alloy and arrive at the composition as claimed. Applicants respectfully disagree with this conclusion for at least the following reasons.

Darolia describes a single-crystal alloy composition. (col. 1, lines 54-57). One characteristic of the Darolia composition is that there are substantially no "grain boundaries" within the single crystal portion. (Column 2, lines 50 to 52). Darolia insists very clearly that,

"[T]he article must be substantially a single crystal (i.e., single grain). It may not be a polycrystal, either a random polycrystal or an oriented polycrystal such as produced by directional solidification" (col. 2, line 60-63).

Darolia goes on to state,

"[I]n the polycrystalline alloys, it has been conventional to add higher levels of elements that are known to strengthen grain boundaries, such as carbon, boron, hafnium, zirconium. Zirconium and hafnium are chemically reactive, modify the morphologies of precipitate phases, and may adversely affect the heat treatment of the alloys. Because these elements are not needed to strength[en] high-angle grain boundaries[,] which are not present in substantially single-crystal articles, it has therefore been the prior practice to omit them from single-crystal articles except in very minor amounts to strengthen the low-angle grain boundaries that may be present" (col. 2, line 63 to col. 3, line 7).

The subsequent discussion makes it clear that in Darolia, a key aspect is controlling the levels of the grain-boundary strengthening elements. However, Darolia is very particular about which elements are to be used, and in what amounts. Darolia states:

"As indicated, the hafnium or zirconium may not be present in the modified nominal nickel-based superalloy composition in any amount that would have a substantial adverse affect on the mechanical or/and physical properties of the base alloy composition in its service application. For these same reasons, only hafnium and zirconium have been determined to be candidates for the modifying elements. Other elements which may potentially improve the properties of the alloy must be added to the base composition in too great a concentration to be acceptable. For example, for the amount of silicon necessary to impart beneficial effects to the properties of the article would require its concentration to be so large that it would adversely affect the properties of the alloy through increased long-term microstructural instability. The amount of yttrium necessary to impart beneficial effects to the properties of the article would require its concentration to be so large in the alloy that it would cause excessive incipient melting during solution heat treat[ment]. Silicon and yttrium additions to the base compositions therefore do not come within the scope of the present invention" (col. 4, lines 42-6, emphasis added).

In contradistinction from Darolia, the claimed alloy composition of the instant application includes about 0.05 to 0.3 wt% silicon. In fact, the inventors consider the combination of 0.05 to about 0.3 wt% silicon and about 0.003 to about 0.01 wt% boron to be a particularly preferred aspect of the invention, yielding a surprising beneficial advantage in nickel alloy compositions (see specification at page 2, lines 9-23). This combination of boron and silicon had been found, surprisingly, to reduce the melting temperature of the alloy,

yielding substantial advantages in deposition methods, as the energy consumption of the deposition method is lowered by virtue of the lower melting temperature of the alloy.

The fact that Darolia explicitly and unmistakably teaches that the addition of silicon is to be entirely avoided, coupled with the unexpected advantage found with the claimed combination of silicon and boron, provides excellent evidence of a non-obvious modification of the Darolia disclosure.

Despite Darolia's express teachings to avoid the use of silicon, the Office Action alleges that nevertheless, the teachings of Naik would have motivated a person of ordinary skill in the art to add silicon to the Darolia alloy composition. It is clear, however, that such motivation would require a very explicit reference in Naik to teach the advantages of silicon in single-crystal alloys where silicon is otherwise considered to be detrimental. Such a teaching is not at all present in Naik.

First, Naik fails to teach any significance to the use of silicon. Silicon is not an essential element of the Naik composition; it may be omitted entirely and replaced by hafnium. (Naik, col. 5, lines 6-26). Naik's options for silicon are all presented as of equal status, with none being preferred. According to Naik, the options are: (1) omit silicon entirely and replace it by hafnium, (2) use silicon in combination with hafnium, or (3) use silicon in the absence of hafnium. All three options are provided equal status; Naik does not disclose any advantage to using or preference for involving silicon. (col. 5, lines 27-40). Thus, Naik fails to provide any motivation or suggestion for an alloy composition that includes silicon.

Second, Naik states that the alloy composition's improved oxidation and corrosion resistance is due to "improved scale integrity and stability which improves the stability of the oxide formed at high temperature." (col. 5, lines 46-49). Indeed, although the alloy includes "minor additions of Hf and Si either singly or in combination," (col. 5, lines 49-51), Naik

states that the "new and improved properties of the present single-crystal superalloy composition over related compositions of the prior art result from critical additions of rhenium, vanadium and/or niobium, platinum, yttrium and/or lanthanum." (col 5, lines 57-61). Again, Naik fails to provide any reason that would suggest to or motivate one of ordinary skill in the art to include silicon in the Darolia alloy composition.

For at least these reasons alone, Darolia and Naik, alone or in combination, would not have taught or suggested to one of ordinary skill in the art the claimed alloy composition. Initially, Darolia positively states that silicon is to be avoided. Naik then discloses absolutely no preference for including silicon in the alloy.

In conclusion, the combination of Darolia and Naik would not have rendered claim 1 obvious to one of ordinary skill in the art. Claims 2-5, depending from claim 1, would also not have been obvious. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

**B. Claims 7 and 11-14**

The Office Action rejects claims 7 and 11-14 under 35 U.S.C. §103(a) over Darolia, in view of Naik, and further in view of U.S. Patent No. 5,622,638 to Schell et al. ("Schell") and Applicants' allegedly admitted prior art. Applicants respectfully traverse the rejection for at least the following reasons.

Claim 7 is drawn to a method for forming a blade tip of a gas turbine blade, comprising applying a nickel alloy composition, that includes about 0.05 to about 0.3 wt% silicon, to the tip of the gas turbine blade. Claim 11 further depends from claim 7. Claim 12 is drawn to a method for forming a blade tip or blade tip structure of a gas turbine blade, or for forming a repair structure to repair a cast metal turbine component, comprising laser cladding or weld depositing a nickel alloy composition that includes about 0.05 to about 0.3 wt% silicon. Claims 13-14 further depend from claim 12.

As detailed above in the comments regarding the rejection of claims 1-6, the combined teachings of Darolia and Naik would not have taught or suggested, to one of ordinary skill in the art, a nickel alloy composition that includes about 0.05 to about 0.3 wt% silicon. In particular, Darolia expressly teaches away from an alloy containing silicon while Naik discloses no penchant for including silicon. As such, Darolia and Naik could not have taught or suggested a blade tip formation method using the claimed nickel alloy composition. Schell, and any allegedly acknowledged prior art do not overcome these deficiencies of Darolia and Naik.

Schell describes a method for forming a blade tip on a turbine blade that utilizes a nickel based alloy. Applicants' admitted alleged prior art, cited of page 1, lines 28-33 of the specification, refers to Schell. The Office Action asserts that it would have been obvious to one of ordinary skill in the art to apply the Darolia alloy, as modified in view of Naik, for use on a turbine blade. The Office Action points to Darolia's disclosure of an alloy providing improved mechanical properties for high-temperature applications, such as aircraft gas turbine blades (See, Darolia, col. 1, lines 54-57).

Much like Naik, Schell fails to teach any advantage to including silicon in single-crystal alloys wherein silicon is considered to be detrimental. Like Naik, Schell fails to teach or suggest any significance to including silicon in its alloy. Because Darolia absolutely teaches away from a silicon containing alloy, and in the absence of any explicit reference in Schell teaching or suggesting an advantage to including silicon in a composition in which it is overtly excluded, one of ordinary skill in the art would never have been motivated to make the addition of silicon to the alloy composition as claimed. For at least this reason alone, Darolia, Naik, Schell and the allegedly admitted prior art, in any possible combination, would not have rendered obvious the methods of claims 7 and 11-14.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

**C. Claims 8-10**

The Office Action rejects claims 8-10 under 35 U.S.C. §103(a) over Darolia, in view of Naik, and further in view of U.S. Patent No. 6,468,367 to Mukira et al. ("Mukira") and Applicants' allegedly admitted prior art. Applicants respectfully traverse the rejection for at least the following reasons.

Independent claim 8 is drawn to a method for repairing a metal article comprising applying a nickel alloy composition that includes silicon to a damaged portion of the metal article, and claims 9-10 depend from claim 8. The Office Action recognizes that Darolia and Naik do not teach or suggest a method for repairing a metal article that includes applying the nickel alloy composition as claimed. The Office Action states that Mukira teaches that it is common to apply a repair alloy to a damaged turbine blade by arc welding and concludes that it would have been obvious to apply the alloy of Darolia and Naik in the repair method of Mukira with the expectation of improved mechanical properties.

As detailed in the above remarks, the combined teachings of Darolia and Naik would not have taught or suggested any nickel alloy composition that includes silicon, as claimed, to one of ordinary skill in the art. Moreover, Mukira and Applicants' allegedly admitted prior art do not cure the deficiencies of Darolia and Naik.

Mukira describes the cost efficient welding repair of turbine components using an alloy composition that contains numerous metal components including about 0.5 to 1.5 wt% silicon. Applicants' allegedly admitted prior art is Schell. However, just like Naik and Schell, Mukira also does not teach any advantage to including silicon in the alloy composition. Mukira fails to provide any teaching or suggestion that would have motivated

one of ordinary skill in the art to include silicon in a composition that Darolia expressly stated must not contain silicon.

For at least this reason alone, Darolia, Naik, Mukira and Applicants' allegedly admitted prior art would not have rendered obvious the methods of claims 8-10. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

## **II. Wukusick and Naik**

### **A. Claims 1-6**

The Office Action rejects claims 1-6 under 35 U.S.C. §103(a) over GB 2,235,697 to Wukusick et al. ("Wukusick") in view of Naik. Applicants respectfully traverse the rejection.

Claim 1 is drawn to a nickel alloy composition that includes about 0.05 to about 0.3 wt% silicon, and claims 2-6 depend from claim 1. However, Wukusick and Naik, alone or in combination, do not teach or suggest such an alloy composition.

The Office Action recognizes that just like Darolia, Wukusick also fails to teach or suggest a nickel-base alloy composition containing silicon. The Office Action relies on Naik for teaching the addition of silicon to a nickel-base alloy to improve oxidation and corrosion resistance and concludes that it therefore would have been obvious to one of ordinary skill in the art to add an amount of silicon overlapping the claimed range to the Wukusick alloy.

The Office Action maintains that one of ordinary skill in the art would be motivated to optimize the alloy composition in order to achieve improved grain boundary strengthening. However, similar to Darolia, Wukusick teaches a single-crystal superalloy that does not include grain boundaries. For at least this reason alone one of ordinary skill in the art would have no reason or motivation to include silicon in an attempt to alter the grain boundary properties of the Wukusick alloy.

Naik also fails to provide any suggestion or motivation to further include silicon in the Wukusick alloy composition. As detailed above, Naik has no preference for including

silicon. Silicon is not an essential element of the Naik composition and it may be entirely omitted or replaced by hafnium. Thus, Naik fails to provide any suggestion or motivation to include silicon in the Wukusick alloy composition. Contrary to the position of the Office Action, Wukusick and Naik would not have rendered claims 1-6 obvious to one of ordinary skill in the art.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

**B. Claims 7 and 11-14**

The Office Action rejects claims 7 and 11-14 under 35 U.S.C. §103(a) over Wukusick, in view of Naik, and further in view of Schell and Applicants' allegedly admitted prior art. Applicants respectfully traverse the rejection.

Independent claim 7 is drawn to a method for forming a blade tip of a gas turbine blade, comprising applying a nickel alloy composition, that includes about 0.05 to about 0.3 wt% silicon, to the tip of the gas turbine blade. Claim 11 depends from claim 7. Independent claim 12 is drawn to a method for forming a blade tip or blade tip structure of a gas turbine blade, or for forming a repair structure to repair a cast metal turbine component, comprising laser cladding or weld depositing a nickel alloy composition that includes about 0.05 to about 0.3 wt% silicon. Claims 13-14 depend from claim 12.

As detailed in the above comments, the combination of Wukusick and Naik would not have taught or suggested a nickel alloy that includes about 0.05 to about 0.3 wt% silicon. In particular, Wukusick teaches away from including silicon in a nickel alloy while Naik discloses absolutely no preference for including silicon. Schell, and any allegedly acknowledged prior art, also do not teach or suggest a nickel alloy including silicon. As such, Wukusick, Naik, Schell and any allegedly acknowledged prior, either alone or in



combination, could not have taught or suggested any methods using the claimed nickel alloy composition.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

**C. Claims 8-10**

The Office Action rejects claims 8-10 under 35 U.S.C. §103(a) over Wukusick, in view of Naik, and further in view of Mukira. Applicants respectfully traverse the rejection.

Independent claim 8 is drawn to a method for repairing a metal article comprising applying a nickel alloy composition that includes silicon to a damaged portion of the metal article, and claims 9-10 depend from claim 8. The Office Action recognizes that Wukusick and Naik do not teach or suggest a method for repairing a metal article that includes applying the nickel alloy composition as claimed. The Office Action states that Mukira teaches that it is common to apply a repair alloy to a damaged turbine blade by arc welding and concludes that it would have been obvious to apply the alloy of Wukusick and Naik in the repair method of Mukira with the expectation of improved mechanical properties.

As detailed above, Wukusick and Naik would not have taught or suggested to one of ordinary skill in the art a nickel alloy composition that includes silicon, while Mukira does not teach any advantage to an alloy composition that includes silicon. Mukira fails to provide any teaching or suggestion that would have motivated one of ordinary skill in the art to produce or use a nickel-based alloy that includes silicon for repairing metal articles.

For at least this reason alone, Wukusick, Naik, and Mukira would not have rendered obvious the methods of claims 8-10. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

**III. DeBussac and Hino**

**A. Claims 1 and 4**

Claims 1 and 4 are rejected under 35 U.S.C. §103(a) over FR 2,780,983 to DeBussac et al. ("DeBussac") in view of US 2002/0062886 to Hino et al. ("Hino"). Applicants respectfully traverse the rejection.

Applicants claim the benefit of the November 18, 2000 filing date to British Patent Application No. 0028215.2. Applicants submitted a Claim for Priority and provided a certified English language copy of the British Patent Application on January 23, 2002. The Office Action acknowledges that all certified copies of the priority documents have been received. British Patent Application No. 0028215.2 satisfies the 35 U.S.C §112, first paragraph, requirements for claims 1-20. Accordingly, the instant application is entitled to the benefit of the November 18, 2000 priority date.

Hino was filed on August 30, 2001 and published on May 30, 2002. Because the instant application's priority date precedes Hino's filing date, Hino can not serve as a reference under 35 U.S.C. §103.

The nickel alloy composition in claim 1 includes about 0.04 to about 0.1 wt% C, and about 0.003 to about 0.01 wt% B. As acknowledged in the Office Action, DeBussac fails to teach any content of carbon or boron in its alloy. The Office Action asserts that Hino would have suggested to one of ordinary skill in the art modifying DeBussac to include the claimed amounts of boron and carbon. However, for the reasons stated above, Hino cannot serve as a reference in combination with DeBussac.

Accordingly, for at least this reason alone, the rejection should be withdrawn. Applicants respectfully request reconsideration and withdrawal of the rejection.

**B. Claims 7 and 11-14**

Claims 7 and 11-14 are rejected under 35 U.S.C. §103(a) over DeBussac in view of Hino, further in view of Shell and Applicants' allegedly admitted prior art. Applicants respectfully traverse the rejection.

As acknowledged in the Office Action and detailed above, DeBussac does not teach or suggest a nickel alloy composition that includes about 0.04 to about 0.1 wt% C, and about 0.003 to about 0.01 wt% B as claimed. Hino cannot serve as a reference under §103. The secondary references, Shell and Applicants' allegedly admitted prior art, do not remedy the deficiencies of DeBussac. Once again, the secondary references do not disclose anything that would have taught or suggested to one of ordinary skill in the art to include the claimed amounts of boron and carbon in a nickel alloy composition. Thus, the combination of cited references would not have rendered obvious claims 7 and 11-14.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

**C. Claims 8-10**

Claims 8-10 are rejected under 35 U.S.C. §103(a) over DeBussac in view of Hino, further in view of Mukira. Applicants respectfully traverse the rejection.

As explained in the above remarks, DeBussac does not teach or suggest a nickel alloy composition that includes about 0.04 to about 0.1 wt% C, and about 0.003 to about 0.01 wt% B as claimed. Hino cannot serve as a reference under §103 and Mukira does not remedy the failed teachings of DeBussac.

Mukira contains nothing that would have taught or suggested to one of ordinary skill in the art to include the claimed amounts of boron and carbon in a nickel alloy composition. Thus, the combination of DeBussac and Mukira would not have rendered obvious claims 8-10.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

**IV. Conclusion**

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-20 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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